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TECHNIQUES AND TOOLS FOR VIRTUAL AND REMOTE EXPERIMENTS

Introduction

The question of virtual and remote labs development and integration in common e-learning infrastructure is very popular last years.

Many engineering and science studies, including on material sciences, are based on theoretical knowledge. Engineering students nevertheless also need a lot of practical work/laboratories to acquire the knowledge and skills in procedures they will have to use in their professional career. Since time and other resources are limited to make available real life infrastructure in a classroom teaching environment, the introduction of a remote and virtual lab environment is considered as an efficient tradeoff between the necessity for lab work, and the above mentioned boundary conditions [1].

The blended learning approach shows the most efficient results among different approaches with the usage of e-learning systems. Blended learning is the combination of different methods of learning and teaching.

For the realization of a blended learning environment a multi-disciplinary team needs to be put together: the design and construction of the labs needs a lab specialist, the programming and net-integration needs software engineers and programmers, the use of the tool needs pedagogues. Only a sound cooperation will yield useful results.

Requirements for virtual and remote experiments

Virtual labs are a supporting tool for quick checking of experimental results, for simulated experiments. It is very useful for mass experimenting on a phenomenon at a very low cost. As it is only simulated, it does not offer the same sense of reality as a remote lab, but it gives the student the opportunity to repeat the experiment endlessly. Simulation means software made experiments. Although simulations can be used to overcome the disadvantages of traditional laboratories, any simulation is simply a model of a physical process, which is just an approximation that cannot reproduce every aspect of the real phenomenon. Some of the advantages of virtual laboratories are the availability of the experiments 24/24h, 7/7 days a week, the low cost of the experiment (only cost is the computer cost, and development cost of the software experiment) and possibility to simulate hazardous experiments. Since it is only

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virtual (software), no safety precautions have to be taken by the user, nor the provider of the experiment.

Remote labs aims to give students the opportunity to test on (less complicated) infrastructure, still experimenting on real experiments. Students can vary parameters, make choices, observe, measure and analyze as in the real lab. It is in fact a real lab, controlled from a different (distant) place.

Example of an e-learning environment for studying for engineering students

In the faculty of engineering technology of KU Leuven –campus De Nayer the Computer Aided Learning Module (CALM) was developed for supporting students in their study on material sciences. The CALM is a blended learning platform, combining classroom teaching, an e_learning platform, physical, remote and virtual labs. For the 2-point bending test (to determine Young's modulus) a remote laboratory to measure material stiffness and its relation to shape stiffness was constructed, in combination with a virtual lab.

Different techniques are combined: hypertext linked contents, virtual lab (ActionScript) and a remote lab (For the realization was chosen the Spring MVC Framework. The basic logic was realized with java, for visualization were used HTML, CSS, Javascript, JQuery, JSP.) [1].

Conclusion

The requirements for the construction of a virtual lab and remote lab can be clearly divided in 2 categories: the technical requirements and the pedagogical requirements.

The most important question is how to use the lab in the pedagogy of a subject. The use of the lab has an impact on its technical requirements.

For pedagogical purposes the visualization and interactivity of the remote and virtual laboratory are among the most important features. This means the lab should be easy to operate, contain self supporting help, should be visually attractive and should be as fool-proof as is possible.

Developed environmental for the material science courses is an example of multi-disciplinary and multinational team work.

References

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